REMARKS

Claims 1-15 are pending in the application. Claims 1-15 are rejected. Claim 14 is herein amended.

Objections to the Claims

In claim 14, the Examiner notes that that the acronyms "TEOS" and "TMOS" should be spelled out in their first occurrence in the claim. Applicants include this amendment herein.

Claim Rejections - 35 U.S.C. §103

Claims 1-15 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,506,497 to Kennedy et al.

The Examiner acknowledges that Kennedy et al. does not specifically state that a porous SOG film is formed after its heat treatment steps, but the Examiner asserts that a porous SOG film would inherently result from the process of Kennedy et al. because the materials and process steps of Kennedy et al. are materially similar to those claimed by Applicant. Additionally, the Examiner notes that an acid hydrolysis reaction occurs in the process of Kennedy et al., and that the solvent and water and surfactant necessarily evaporate during the heat treatment of Kennedy et al. because solvent, water and surfactant are not left in the resulting SOG film.

Applicants respectfully disagree with the above rejections, and submit that there is no motivation for one skilled in the art to have modified Kennedy et al. to arrive at the claimed invention.

With respect to claims 1 and 8, Applicants note that according to the presently claimed invention, an SOG film having a porous structure and a low relative dielectric constant is prepared by subjecting an organic silane to hydrolysis and then heat-treating the resulting system in the presence of a surfactant, and the porous SOG film thus obtained can be used as an interlayer insulating film.

On the other hand, Kennedy et al. relates generally to spin-on glass materials and more specifically to light-absorbing spin-on glass materials for use as anti-reflective layers that are used in exposing a photoresist layer to ultraviolet radiation through mask and methods of producing the materials. In this case, as recited in the cited reference at col. 2, lines 13-15, "What is needed is an absorbing spin-on glass anti-reflective coating material that absorbs strongly and uniformly in the deep ultraviolet spectral region." The cited reference is concerned with producing a SOG film that has very little reflection, so as to reduce distortion of printed patterns thereon. Kennedy et al. teaches merely a reaction mixture including one or more organic light-absorbing compounds, in order to produce the film having very little reflection. In the cited reference, there is no need, teaching or suggestion for producing a ***porous*** SOG film as claimed.

As discussed above, the cited reference differs from the invention of the present application in the purpose of using the SOG film and in the function of the SOG film. Therefore, even though the materials (for forming the SOG film) and process steps of the cited reference are in part similar to those presently claimed, Applicant submits that the cited reference has no intention of obtaining the porous film, which has the low relative dielectric constant, by heat-treating the materials in the presence of the surfactant.

The Examiner notes that the cited reference teaches that a method preparing the SOG film comprises preparing a reaction mixture including silane reactants, one or more absorbing compounds, a solvent such as 2-propanol or other simple alcohols, and an acid/water (col. 6, lines 22-37), and that optionally surfactants are also added to the coating solution (col. 6, lines 54-57). Moreover, after acknowledging that the cited reference does not specifically state that a porous SOG film is formed after its heat treatment steps, the Examiner asserted that a porous SOG film would inherently result from the reference's process.

Applicants respectfully disagree with this assertion. Applicants note that although the cited reference does not make reference to any properties of the surfactants to be used, the optionally added surfactants, such as the product FC 430, provided by 3M, and the MEGAFACE series (R08), provided by DIC (Japan), are organofluoro surfactants used for decreasing the surface tension of the coating solution and decreasing the probability of formation of bubble film defects. For instance, FC 430 is used as a bubble breaker. It is the Applicant's position that the purpose of using the surfactants in the cited reference is the same as that of the solvents (col. 6, lines 45-47), which is taught in the same paragraph (col., lines 38-60) as the surfactants.

Therefore Applicants submit that the films of the cited reference are not porous as presently claimed. Therefore, Applicants submit that the characteristics and the techniques of the cited reference would be contraindicated due to the difference in films. In other words, in the case that the SOG films were to be made porous, one skilled in the art not have used the techniques of the cited reference in view of differences in the characteristics of the surfactants used. Such being the case, one skilled in the art would not have been led to follow the teachings of the cited reference.

Therefore, Applicants respectfully submit that claims 1 and 8 are not obvious from the cited reference due to the reasons as discussed above.

As to claim 2, the Examiner asserts that it would have been obvious to have formed a second SOG film layer on top of the first SOG film layer in place of forming one thicker SOG coating film because splitting one step into two is an obvious and unpatentable variation.

Applicants note that claim 2 relates to the preparation of a multi-layered porous film, in which an additional porous film is formed on top of the porous film, by repeating the steps of claim 1, whereby it becomes possible to inhibit any penetration of moisture such as water vapor through the surface of the porous film and to reduce the hygroscopicity of the porous film, as well as the resulting porous film has a low relative dielectric constant, whose dielectric constant does not change even when depositing another film on the surface of the multi-layered porous SOG film (the interlayer insulating film) after forming the interlayer insulating film.

As mentioned above, the effect of the invention of the present application is entirely different from that of the cited reference. As noted on page 6, lines 3-9 of the present specification, because of the lamination of the multilayer film, the porous films constituting the laminate are put in layers while the holes present in every neighboring porous films and arranged perpendicularly to the substrate deviate from one another and therefore, the holes present in the upper film have almost no communication with those in the lower film; there is almost no through hole in the multi-layered film. Thus, the moisture absorption of the laminated porous film can be controlled.

Applicants further note that because claim 2 depends on claim 1 and naturally includes its limitations, and because claim 1 is asserted above to be not obvious over the cited reference, Applicants submit that claim 2 is not obvious over Kennedy et al.

As to claims 4 and 10, it is the Examiner's position that it would have been obvious to have used two anti-reflective coatings in combination, such as silicon oxynitride and the light-absorbing SOG film of the invention, with an expected result of improved anti-reflectance qualities over the use of one layer alone.

With respect to claims 4 and 10, Applicants note that Kennedy et al. teaches at col. 7, lines 25-27 that the SOG coating solutions are generally applied to various layers in semiconductor processing and at col. 1, lines 53-63 that silicon oxynitride has been used as a material for an anti-reflective coating up to now.

Applicants note that claims 4 and 10 relates to the preparation of a multi-layered porous SOG film, in which a hydrophobic film such as a silicon oxynitiride film is formed on the surface of the porous film formed according to the steps as set forth in claims 1 or 8 so as to coat or cap the surface of the porous film of claims 1 or 8. As a result of such lamination, penetration of moisture such as water vapor through the surface of the porous film is inhibited and the hygroscopicity of the porous film is reduced. Furthermore, the resulting porous film has a low relative dielectric constant that does not change even when depositing another film on the surface of the multi-layered porous SOG film.

Because claims 4 and 10 depend on claims 1 and 8, respectively, and because claims 1 and 8 have been shown above to be not obvious over the cited reference, Applicants submit that claims 4 and 10 are not obvious from the cited reference.

As to claims 3 and 9, it is the Examiner's position that it would have further been obvious to have used a plurality of the anti-reflective coatings taught by Kennedy et al. (both silicon oxynitride and the absorbing SOG of the invention) with the exception of even further improved anti-reflectance qualities.

Similar to the above remarks, because claims 3 and 9 depend on claims 2 and 8, respectively, and because claims 2 and 8 have been shown above to be not obvious over the cited reference, Applicants submit that claims 3 and 9 are not obvious from the cited reference.

As to claims 5 and 11, the Examiner asserts that the irradiation step would inherently remove unreacted OH groups remaining in the SOG film.

With respect to claims 5 and 11, Applicants note that the cited reference teaches at col. 7, lines 60-63 that the absorbing SOG anti-reflective coating layer efficiently absorbs UV light so as to prevent a critical dimension of the exposed photoresist from becoming degraded due to the reflected light transmitted through the photoresist. There is no teaching or suggestion that further coating layers would result in any benefit. Furthermore, Kennedy et al. does not entirely teach that unreacted OH groups can be removed as H_2O according to the reaction taken place in the UV irradiation step as taught in the specification.

Applicants note that claims 5 and 11 depend on claims 1 and 8, respectively, and because claims 1 and 8 have been shown above to be not obvious over the cited reference, Applicants submit that claims 5 and 11 are not obvious from the cited reference.

As to claim 6, the Examiner notes that Kennedy et al. teaches that the exemplary heat treatment described in col. 7, lines 32-34 comprises two or three bake steps at temperatures between 80 °C and 300 °C for about one minute each. The Examiner asserts that heat treatment

at a first lower temperature would perform evaporation and the second heat treatment at a second higher temperature would cover the inner walls of holes with hydrophobic moieties of surfactant because the materials and process steps are similar to those claimed by Applicant.

With reference to claim 6, Applicants note that Kennedy et al. does not teach the purpose of two or three bake steps carried out at temperatures between 80°C and 300°C (beyond the confines of the invention). As discussed above, the surfactants used in the cited reference differ from the invention in the properties thereof. Further, the SOG film of the cited reference is not porous in the sense that the inventive films are, as detailed above. Therefore, Applicants submit that the bake steps in the cited reference significantly differ from the two heat-treating steps for forming the porous film as set forth in the claim 6.

Furthermore, because claim 6 depends on claim 1 and naturally includes at least its limitations, and because claim 1 has been show to be not obvious, above, Applicants submit that claim 6 is not obvious over the cited reference.

With respect to claims 7 and 12, Applicants note that Kennedy et al. teaches at col. 7, lines 32-34 a temperature of 300°C but does not teach the claimed temperatures ranging from 350°C to 450°C. The present specification shows the criticality of the claimed temperatures, as described in the specification, page 9, lines 1-6. Namely, if the temperature is less than 350°C, it is difficult to obtain a porous film having a desired low relative dielectric constant.

Claims 7 and 12 depend on claims 6 and 8, respectively. Therefore, we believe that claims 7 and 12 are not obvious from the cited reference due to the reasons as discussed herein and in connection with claims 6 and 8.

With respect to claims 13 and 14, the Examiner notes that Kennedy et al. lists exemplary surfactants but further notes that Kennedy et al. broadly states that "surfactants" in general are added to the coating solution, and that the exemplary surfactants are merely exemplary. The Examiner asserts that it would have been obvious to have used any surfactant in the coating solution of Kennedy et al., including those claimed by Applicant.

With respect to claims 13 and 14, and as discussed above, the surfactants in the invention of the present application are added for the purpose of forming SOG film. In this contrast, the surfactants in the cited reference are added for the purpose of decreasing the probability of formation of bubble film defects.

Furthermore, claims 13 and 14 depend on any of claims 1-12 and any of claims 1-13, respectively, shown above to be not obvious over the cited reference. Therefore, Applicants submit that claims 13 and 14 are not obvious over the Kennedy et al.

With respect to claim 15, and as noted by the Examiner, the cited reference does not teach the respective amounts of water, acid and surfactant in the coating composition. In contrast, in the invention of the present application, the respective amounts of water, acid or alkali, and surfactant are critical to the invention as disclosed at page 10, lines 21-28 of the specification.

Furthermore, claim 15 depends on any of claims 1-14, shown above to be not obvious over the cited reference. Therefore, Applicants submit that claim 15 is not obvious over the cited reference.

In view of the aforementioned amendments and accompanying remarks, Applicants submit that that the claims, as herein amended, are in condition for allowance. Applicants request such action at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney to arrange for an interview to expedite the disposition of this case.

If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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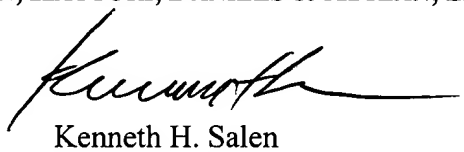

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Enclosures: Data Sheets Related to Surfactants (8 pages)

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